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(71) Applicant(s)
Lintec Corporation

(Incorporated in Japan)

23-23 Honcho, Itabashi-ku, Tokyo 173, Japan

(72) Inventor(s)
Eiichi Irie

(74) Agent and/or Address for Service
Marks & Clerk
57-60 Lincoln's Inn Fields, LONDON, WC2A 3LS,
United Kingdom

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U1S S2088

(56) Documents Cited
GB 2004090 A US 4718967 A
JP 6196555 A , Nitto Denko Corpn,Japanese abstract & Derwent abstract

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INT CL^6 H01L 21/30 21/302 21/78 21/784 21/786
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(54) Illumination apparatus for irradiating dicing tape

(57) Apparatus for irradiating a workpiece in order to weaken the adhesive strength of a photo-setting adhesive used to bond a semiconductor wafer to dicing tape includes a chamber 1 for holding the workpiece W, a high pressure mercury lamp for irradiating the workpiece, and means for controlling the output of the lamp to a constant intensity. A power source equipped with an inverter supplies a rectangular waveform alternating current to the lamp, the light from which is reflected by mirror 7 to the wafer, and directed by light guide 31 to light sensor 33. A base illumination intensity setting control sets the required illumuination intensity and control portion 37 equipped with a microcomputer controls the power outputted from the power source to the lamp to cause the lamp to emit light at the set base illumination intensity. Irradiation is carried out under nitrogen, and the speed of motion between the lamp and the wafer is controlled.

FIG.1

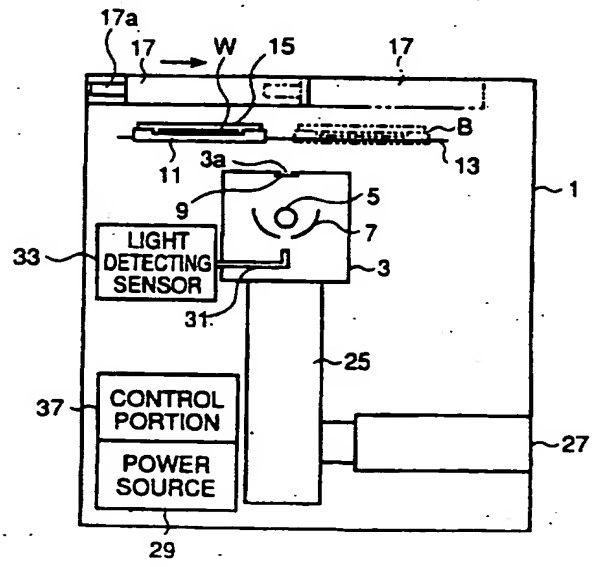

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FIG.1

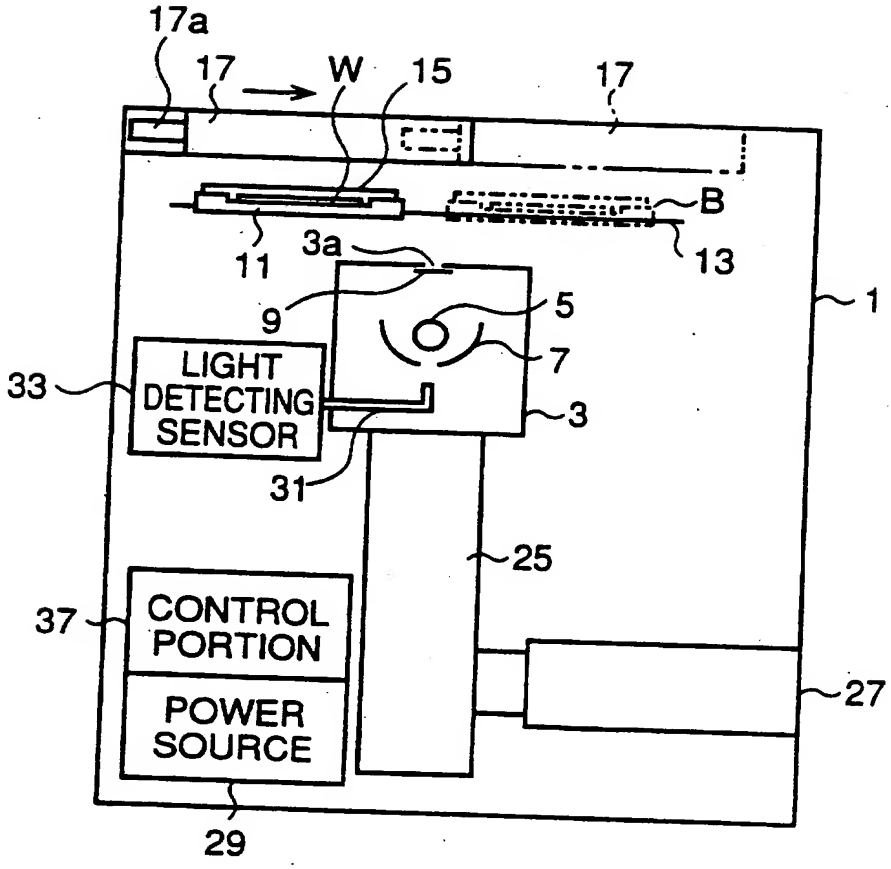

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FIG. 2

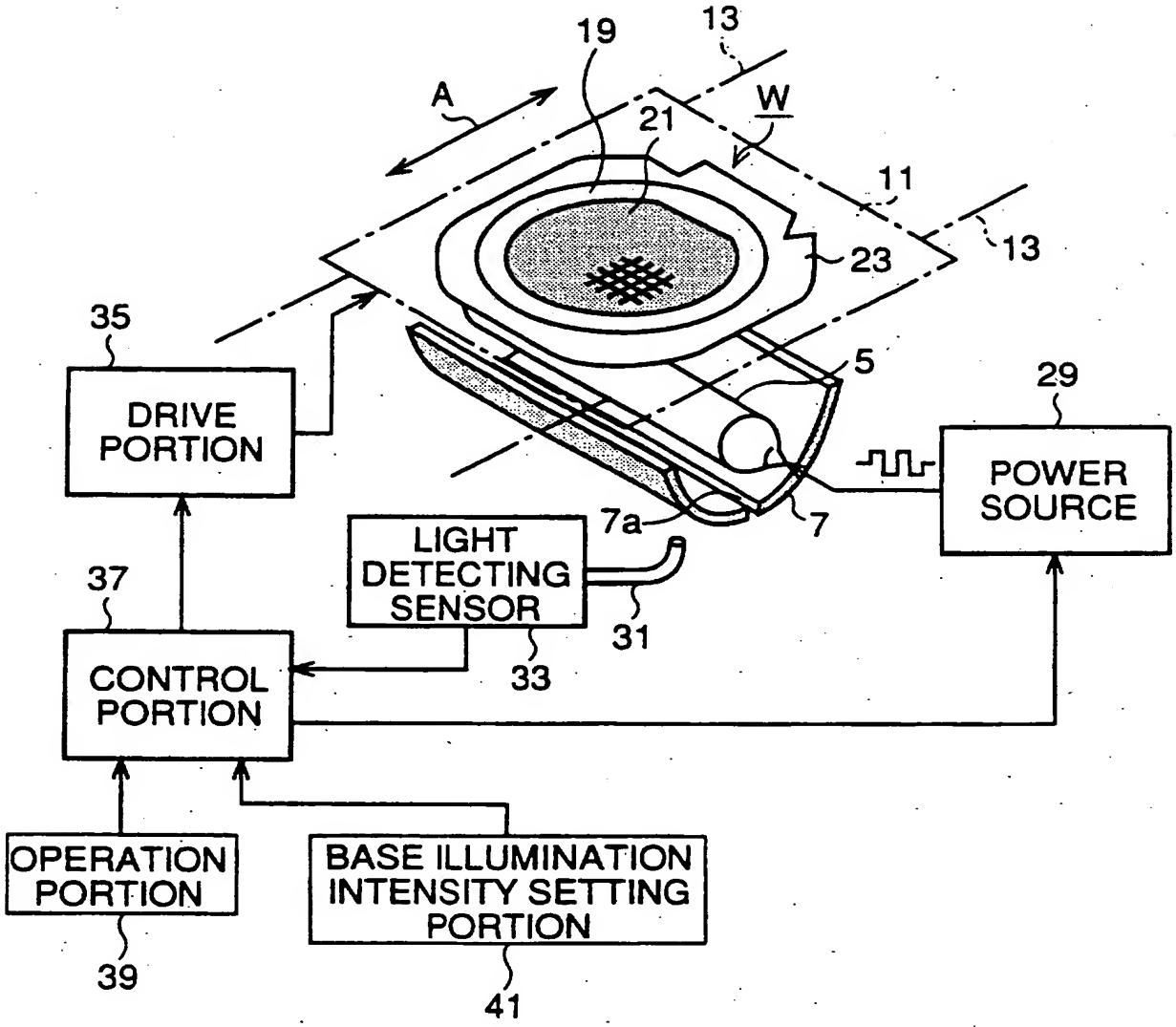

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FIG. 3

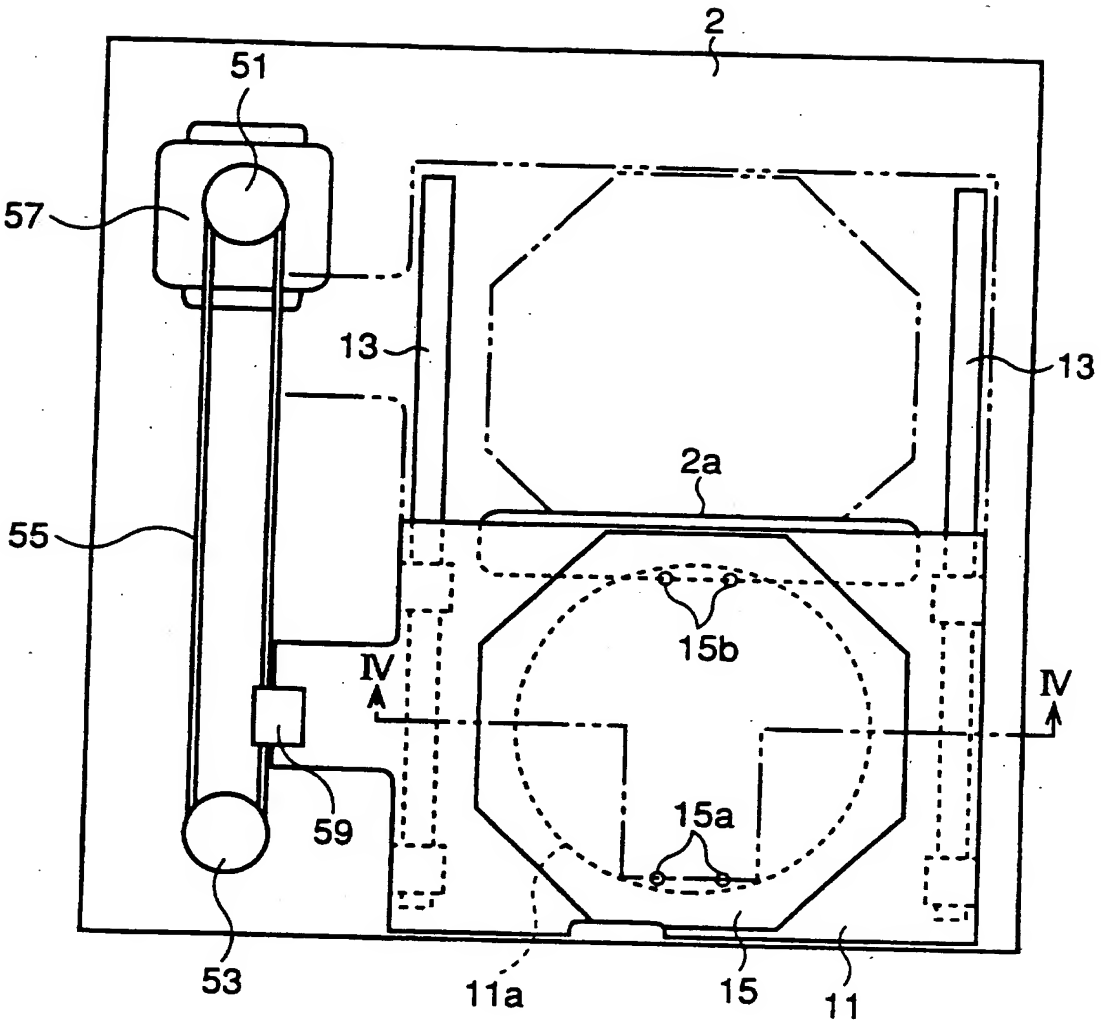

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FIG. 4

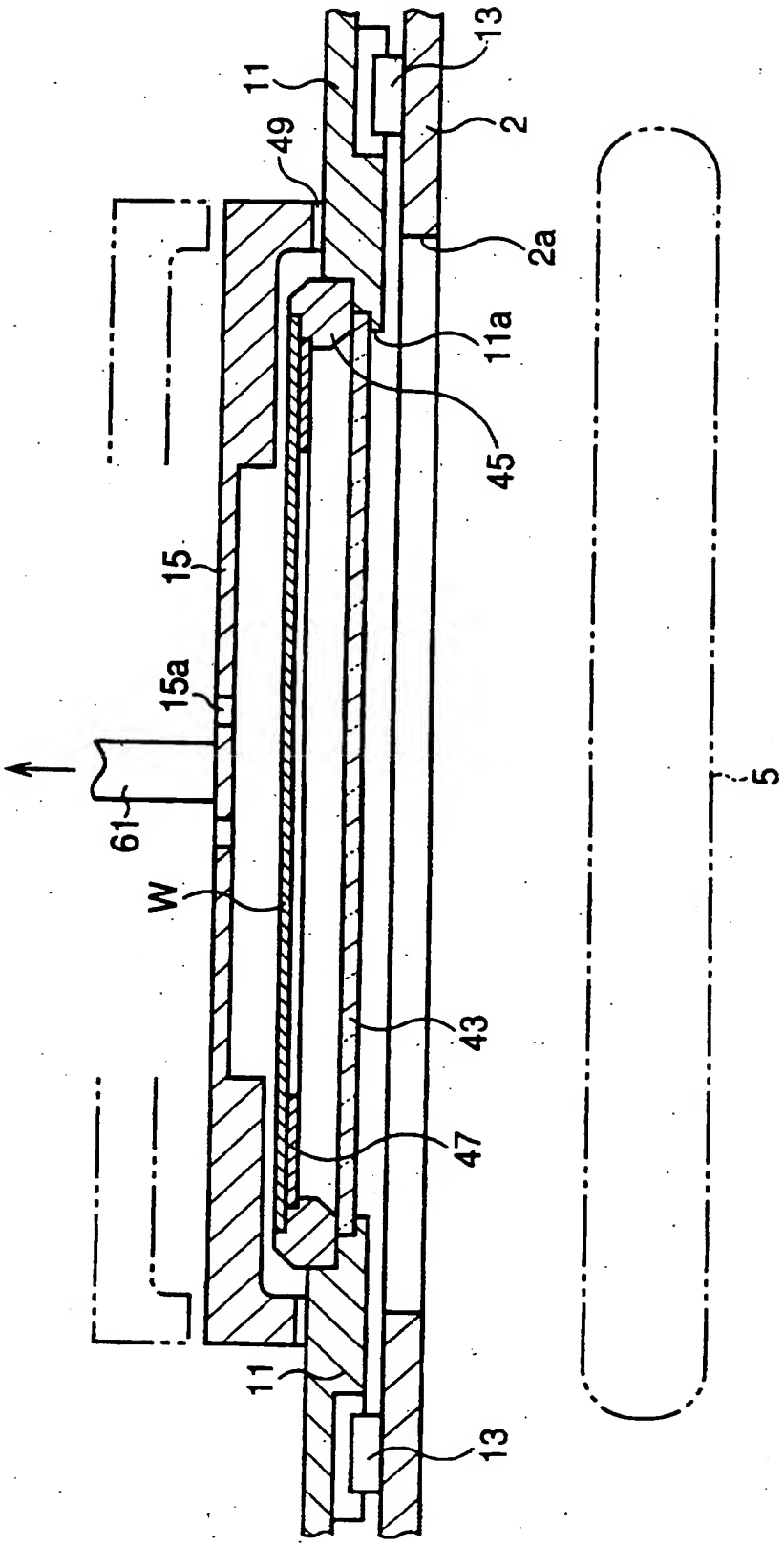

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FIG. 5

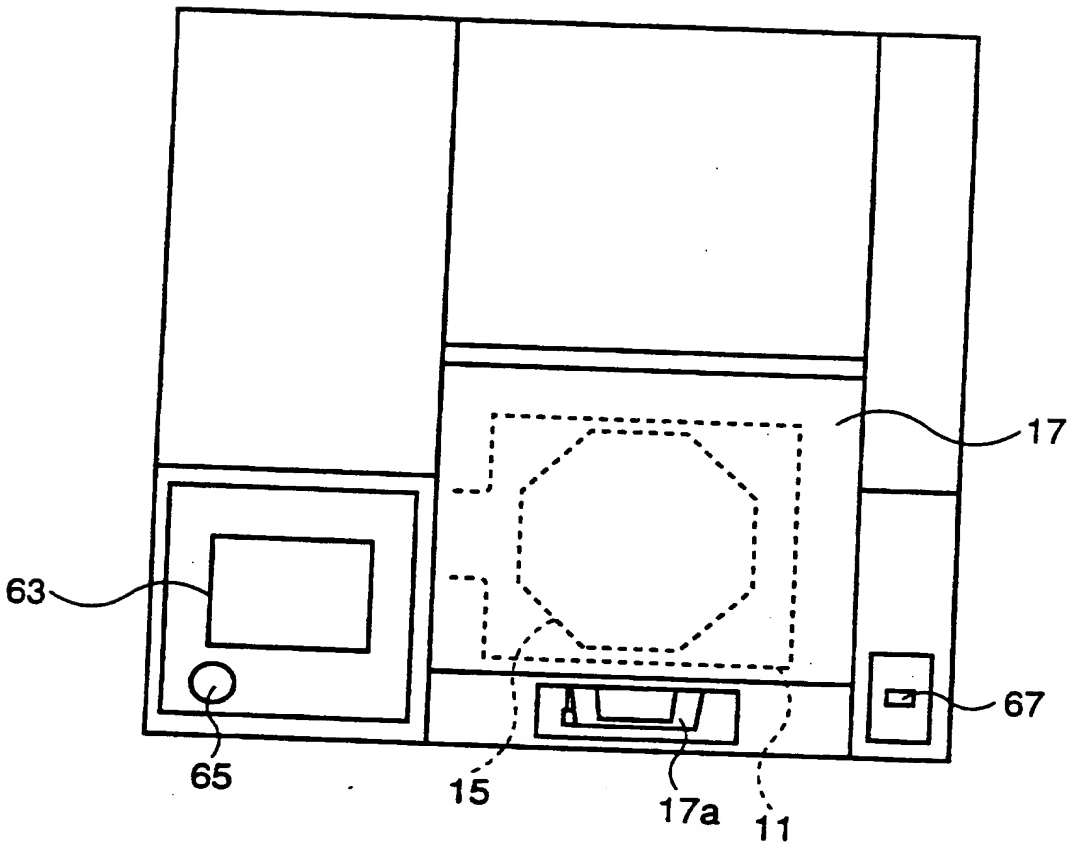

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FIG. 6

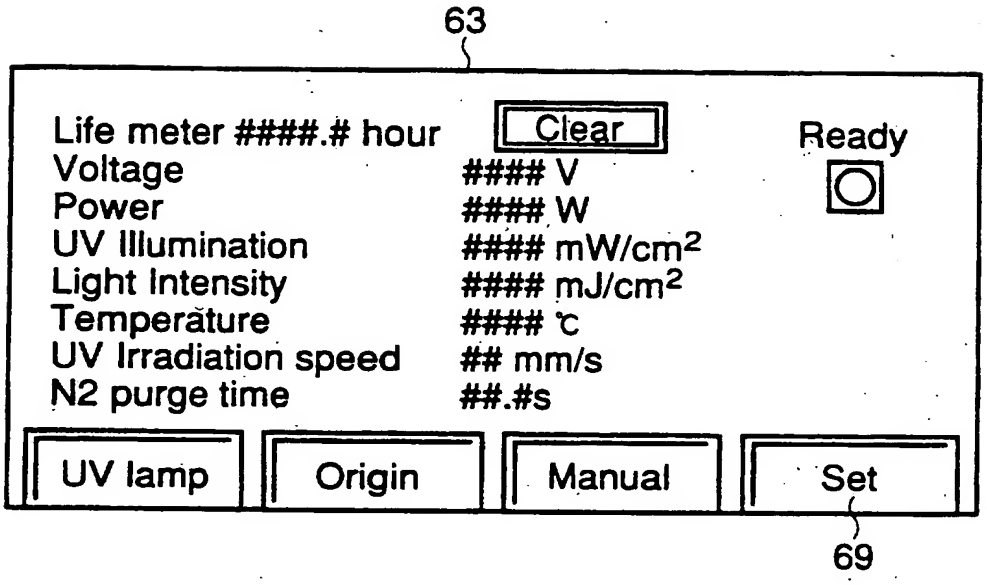

FIG. 7

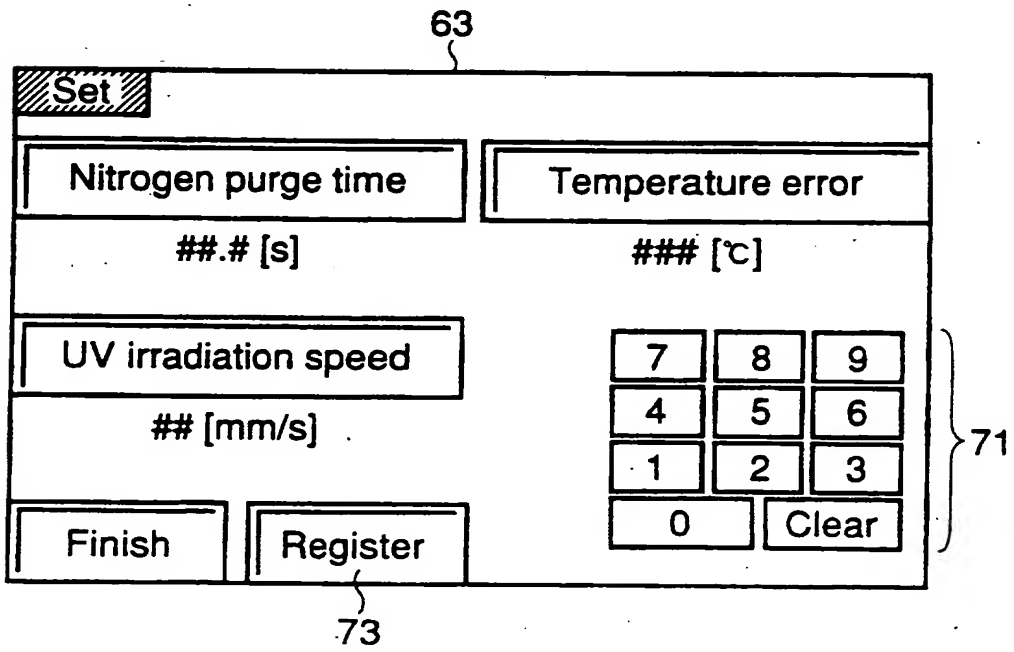

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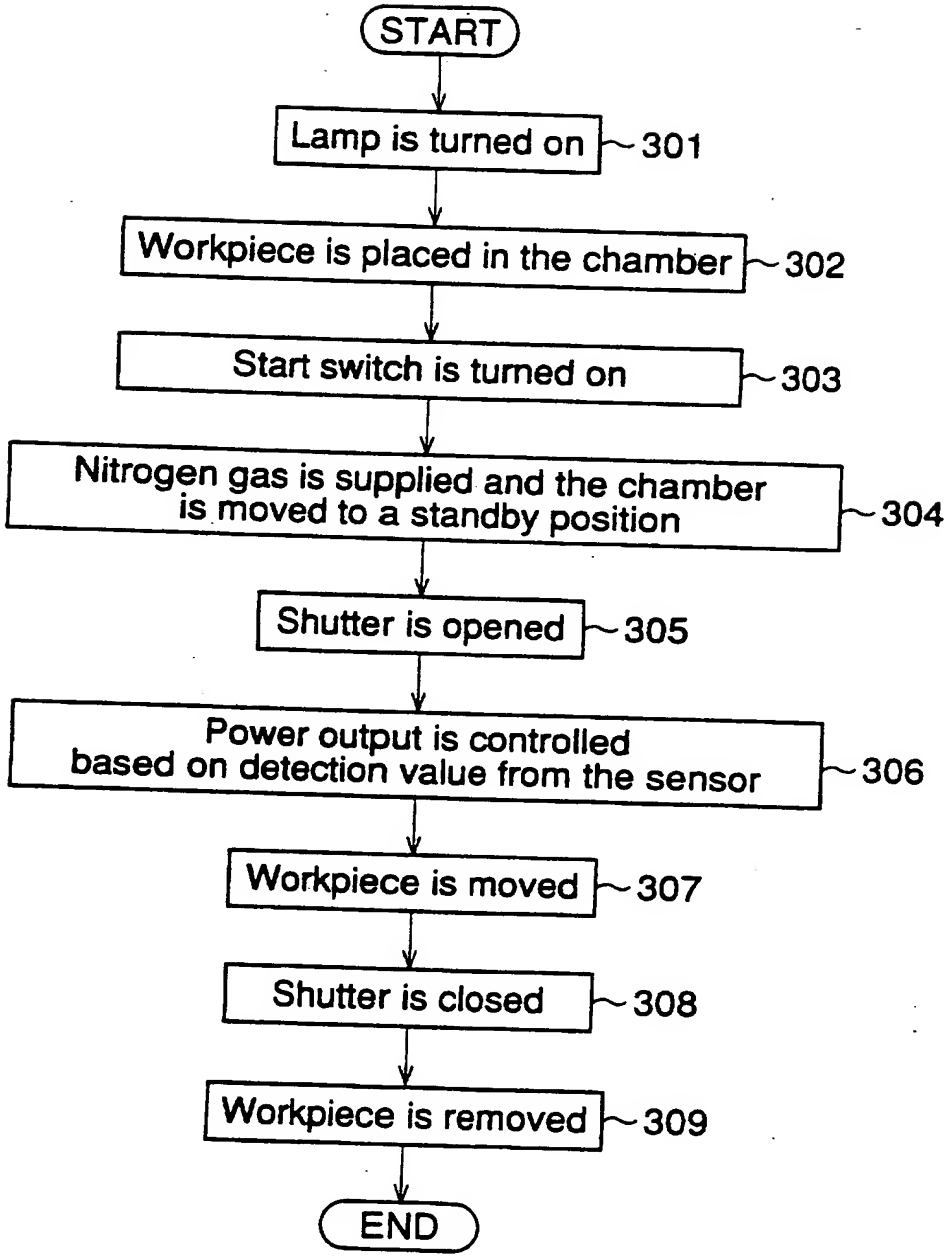
FIG. 8



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TITLE OF THE INVENTION

ILLUMINATION APPARATUS FOR IRRADIATING DICING TAPE AND METHOD OF ILLUMINATION THEREOF

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to an illumination apparatus for irradiating dicing tape, and in particular relates to an illumination apparatus for irradiating dicing tape in order to weaken the adhesive strength of an adhesive applied to the dicing tape.

DESCRIPTION OF THE PRIOR ART

Up to now, when IC chips are being cut out (i.e., diced) from a semiconductor wafer, this is carried out with the semiconductor wafer fixed on top of dicing tape. For fixing such semiconductor wafer, a photo-setting adhesive is applied to this dicing tape. In this arrangement, once dicing is completed, the adhesive is irradiated with light (or radiation) to harden the adhesive and thereby weaken the adhesive strength thereof, after which the IC chips are picked up.

In this connection, illumination apparatuses for dicing tape have been used in the prior art to irradiate the above-described adhesive with light. One example of such an illumination apparatus is disclosed in U.S. Patent No. 4,718,967.

In this type of illumination apparatus, the light source is generally a high pressure mercury lamp or a metal halide lamp or the like. These light sources initially have a high lamp illumination intensity, but after time they suffer a gradual decline in illumination intensity as the

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lamp electrodes deteriorate.

For this reason, taking the deterioration of the lamp into account, such prior art illumination apparatuses are operated at high power from the beginning in order to obtain a sufficient illumination intensity even when the lamp deteriorates. Consequently, when the lamp is new, it is supplied with more power than is necessary, which in turn causes the dicing tape to be irradiated with light having a higher illumination intensity than is necessary.

However, if the lamp illumination intensity is too strong, the semiconductor wafer and the dicing tape can be damaged. Furthermore, if there is a change (i.e., lowering) in the illumination intensity of the light used to irradiate the dicing tape due to deterioration of the lamp, the quantity of the light emitted by the illumination apparatus must be controlled in accordance with such deterioration, and this leads to complex control operations.

SUMMARY OF THE INVENTION

With a view toward overcoming the problems of the prior art, it is an object of the present invention to provide an illumination apparatus which can irradiate dicing tape with light having a prescribed illumination intensity.

In order to accomplish this object, the illumination apparatus according to the present invention is constructed from a light source for emitting light to irradiate a photo-setting adhesive applied to dicing tape in order to harden the adhesive, a power source for supplying electrical power to the light source, means for setting the base illumination intensity, and control means for controlling the power supplied from the power source in order to set the illumination intensity of the emitted light at the base illumination intensity.

At this point, it should be mentioned that the word "light" used in the present application includes visible

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light, ultraviolet light (UV), radiation, and electron beams and the like. Further, the term "illumination intensity" refers to the strength per unit area of such visible light, ultraviolet light, radiation, electron beams and the like.

Furthermore, by providing moving means to move the dicing tape relatively to the light source as the tape is being irradiated with light, it becomes possible to uniformly irradiate the entire surface thereof.

Moreover, by making it possible to adjust the speed of motion created by such moving means, it becomes possible to adjust the quantity of light (illumination intensity x irradiation time) used for irradiating the dicing tape.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a structural outline diagram of an embodiment of the present invention.

Fig. 2 is a block diagram showing the circuit structure of the apparatus shown in Fig. 1.

Fig. 3 is a plan view of a chamber for housing a workpiece.

Fig. 4 is a cross-sectional view taken along line Ⅳ - Ⅳ of Fig. 3.

Fig. 5 is a plan view of the apparatus shown in Fig. 1.

Fig. 6 shows an initial picture of a touch panel.

Fig. 7 shows a set picture of a touch panel.

Fig. 8 is a flow chart used for describing the operations of the apparatus shown in Fig. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 1 shows a model outline of an ultraviolet light illumination apparatus according to one embodiment of the present invention. As shown in this drawing, a lamp case 3 is provided inside an illumination apparatus body 1, and

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inside the lamp case 3, a high pressure mercury lamp (or a metal halide lamp) 5 which serves as a light source is arranged inside a reflecting mirror 7. Further, a slit 3a is formed in the upper surface of the lamp case 3 to enable the light from the lamp 5 to exit the lamp case 3, with the slit 3a being opened and closed by a shutter 9. Provided above the slit 3a is a chamber 11 which is adapted to house a workpiece W, with the chamber 11 being freely slidable along a guide 13 which is fixed to the apparatus body 1.

As shown in Fig. 2, the workpiece W is a semiconductor wafer 21 having an IC circuit formed therein which is bonded to a dicing tape 19 by means of a UV photo-setting adhesive applied to the dicing tape 19. Further, the circumferential portion of the dicing tape 19 is reinforced by a ring frame 23.

Now, as shown in Fig. 1, the chamber 11 includes a recessed portion for holding the workpiece W, with a cover 15 being provided to cover the recessed portion to enable the chamber 11 to form a sealed container. Further, a light permeable window made from UV light permeable glass is formed in the bottom portion of chamber 11. In this arrangement, when a workpiece is to be irradiated, the chamber is filled with nitrogen gas to enable the light which passes through the light permeable window to irradiate the workpiece W in an oxygen-free environment. In this connection, a detailed description of such a chamber can be found in U.S. Patent No. 4,718,967 issued to the present inventor.

As is further shown in Fig. 1, a slide cover 17 is provided to enable the illumination apparatus body 1 to be freely opened and closed. Namely, when a knob 17a of the slide cover 17 is grasped to slide the slide cover 17 in the direction indicated by the arrow (i.e. in the horizontal direction to the right) in Fig. 1, the slide cover 17 is opened up to allow the workpiece W to be inserted or removed. Further, a cooling duct 25, which is equipped with a cooling fan and connected to an exhaust port 27, is

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provided below the case 3.

Now, as shown in the block diagram of Fig. 2, which illustrates an outline of the circuit structure of the illumination apparatus, a power source 29 equipped with an inverter supplies a rectangular waveform alternating current to the lamp 5. Further, in order to carry out cooling, a slit 7a is formed in the bottom of the reflecting mirror 7, whereby the light which is emitted from the lamp 5 passes through the slit 7a and enters the tip of an optical fiber 31 which then guides such received light to a light detecting sensor 33. This light detecting sensor 33 may include, for example, a silicon photodiode or the like. At this point, it should be noted that even though the light-receiving portion of the light detecting sensor 33 is provided directly below the lamp 5 in the example embodiment shown in Fig. 2, the location of the light-receiving portion of the sensor 33 is not limited to this arrangement, and it is possible to arrange the light-receiving portion of the sensor 33 at other locations inside the apparatus body 1 (e.g., above the lamp 5).

Further, a drive portion 35 is provided to move the chamber 11 along the guide 13 (in the direction of the arrow A shown in Fig. 2) and is constructed, for example, from a device which translates torque from a motor into linear motion by means of a ball screw, a rack and a pinion or a pulley and a belt. Also, a control portion 37 is provided to control the power source 29 and the drive portion 35 in accordance with the signal value of signals received from the light detecting sensor 33, and is constructed, for example, from a microcomputer equipped with a CPU and a memory.

An operation portion 39 is provided for setting the speed of motion of the chamber 11 and displaying the operating state of the apparatus. In this connection, by adjusting the speed of motion of the chamber 11, it becomes possible to adjust the quantity of light (illumination intensity x irradiation time) used for irradiating the

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dicing tape 19. In this way, it becomes possible to freely change the speed of motion of the chamber 11 in accordance with the size and type of the semiconductor wafer or the type of dicing tape. A detailed description of the operation portion 39 is given below.

A base illumination intensity setting portion 41 which is constructed, for example, from a potentiometer or the like arranged inside the apparatus body 1 is provided for setting a base illumination intensity. When this potentiometer is operated, the power outputted by the power source 29 changes, which in turn causes a change in the illumination intensity of the lamp 5, and at this time the illumination intensity of the lamp 5 is detected by the light detecting sensor 33 and this detected value is stored as the base illumination intensity. Namely, when setting the base illumination intensity, for example, when using an actual illuminance meter to measure the illumination intensity at the position of the mounted workpiece W when the shutter 9 is open, the base illumination intensity setting portion 41 is operated to set such measured illumination intensity at a desired level (e.g., 120mW/cm^2). When this is done, the output from the light detecting sensor 33 is stored in the control portion 37 as the base illumination intensity. Further, it is also possible to use a base illumination intensity setting portion 41 having a plurality of preset levels which can be selected by an operator in accordance with the type of dicing tape used in the workpiece W.

Next, a more detailed description of the chamber 11 and the operating portion 39 will be given with reference to a specific example. Namely, as shown in Figs. 3 and 4, the chamber 11 is slidably mounted on two guide rails 13 which are fixed to the surface of an upper plate 2 which forms part of the structure of the apparatus body 1. Further, an opening 11a is formed in the chamber 11 to enable light to pass into the chamber 11, and held inside the opening 11a is a light-permeable window 43 made from quartz glass.

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Provided over the edge of the opening 11a is a ring 45 which is plated with aluminum so as to be electrically conductive, and provided on the inner side of the ring 45 is a mask plate 47 which defines the illumination range. In this arrangement, the workpiece W is mounted on top of the mask plate 47 and the ring 45, with the workpiece W being enclosed from above by the cover 15. In this regard, the weight of the cover 15 is utilized to hold the cover 15 in place when it is mounted to the chamber 11 via a silicone rubber packing 49.

The space in which the workpiece W is mounted is formed by a first space defined by the cover 15 and a second space defined by the light-permeable window 43, with a plurality of notches being formed in the ring 45 to enable the first and second spaces to communicate with each other.

Further, the illumination apparatus according to the present invention is equipped with a deoxygenating apparatus to remove oxygen from the inside of the chamber 11. Namely, a supply port 15a for supplying nitrogen gas to the inside of the chamber 11 and an exhaust port 15b for expelling oxygen which exists inside the chamber 11 are formed in the cover 15, with such supply port 15a and exhaust port 15b being connected respectively to a nitrogen tank and a vacuum pump (not shown in the drawings).

As shown in Fig. 3, two pulleys 51, 53 are provided on the upper plate 2 near the chamber 11, with a belt 55 being suspended between the pulleys 51, 53. The pulley 51 is rotated by a motor 57 and one end of the chamber 11 is fixed by a metal fitting 59 to the belt 55, whereby when the motor 57 is rotated to move the belt 55, the chamber 11 is moved along the guide rails 13. In this way, by controlling the speed of the motor 57, it is possible to control the speed of motion of the chamber 11. In this connection, the motor 57, the pulleys 51, 53 and the belt 55 form the drive portion 35 shown in Fig. 2.

As shown in Fig. 4, a shaft 61 is provided at the center of the cover 15. Now, when the chamber 11 is in its

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original position (i.e., the position shown in solid lines in Fig. 1 and in dashed lines in Fig. 5), the shaft 61 is raised by a wedge type elevation device (not shown in the drawing), and at the same time, because the cover 15 is held by the slide cover 17, when the slide cover 17 is slid, the cover 15 moves together with the slide cover 17. Accordingly, when the slide cover 17 is opened, the chamber 11 is also opened to enable a workpiece W to be mounted therein. Now, after inserting a workpiece W, when the slide cover 17 is closed, the cover 15 is forced to move together with the slide cover 17, whereby the cover 15 returns to its position above the chamber 11. Then, when a start switch (described below) is pressed, the above-mentioned elevation device is disengaged, and this allows the cover 15 to fall under its own weight on top of the chamber 11, whereby the chamber 11 becomes sealed. At the same time, the slide cover 17 is locked in place.

As shown in Fig. 5, the operation portion 39 (see Fig. 2) is constructed, for example, from a touch panel 63, an emergency switch 65 and a start switch 67. When the emergency switch 65 is pressed, all operations of the apparatus are immediately stopped. Further, when the start switch 67 is pressed, irradiation with UV light is begun. The touch panel 63 is constructed from a liquid crystal display device or the like and, as shown in Fig. 6, has an initial picture which displays the operating conditions of each part of the apparatus. Namely, as shown in Fig. 6, "Life meter" displays the value of the cumulative operation time of the lamp 5, "Voltage" displays the voltage value of the lamp 5, "Power" displays the electrical power value of the lamp 5, "UV illumination" displays the illumination intensity of the lamp 5, "Light intensity" displays the quantity of light emitted by the lamp 5, "Temperature" displays the temperature inside the lamp case 3, "UV irradiation speed" displays the speed of motion of the chamber 11, and "N2 purge time" displays the length of time in which nitrogen gas is supplied to the inside of the

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chamber 11.

Now, if the "Set" key 69 is pressed, the picture displayed by the touch panel 63 changes to the picture shown in Fig. 7. At this point, if the "Nitrogen purge time" key is pressed, it is possible to set the nitrogen supply time, which can be inputted by operating the ten keys 71. Further, if the "Temperature error" key is pressed, it is possible to set the maximum temperature for the lamp case 3 (with an alarm or warning being emitted if the actual temperature reaches or exceeds this maximum temperature), which can also be inputted by operating the ten keys 71.

Furthermore, if the "UV irradiation speed" key is pressed, it is possible to set the speed of motion of the chamber 11 with the ten keys 71. In this regard, because the lamp 5 emits light at a prescribed illumination intensity, by changing the speed of motion of the chamber 11, it becomes quite easy to change the quantity of light (illumination intensity x irradiation time) used for irradiating the workpiece W.

Moreover, by pressing the "Register" key 73, it is possible to store each of the above-described set values into the memory of the control portion 37.

Next, with reference to the flow chart shown in Fig. 8, a description of the operation of above-described embodiment will be given.

First, when the power switch (not shown in the drawing) is turned on, a rectangular waveform alternating current is supplied from the power source 29 to light up the lamp 5 (Step 301). The electrical power at this time is set at a standby value of, for example, one-half the value of the maximum power outputted by the power source 29. Next, the slide cover 17 is opened and a workpiece W is placed inside the chamber 11 (Step 302). Then the slide cover 17 is closed and the start switch 67 is turned on (Step 303). When this is done, the cover 15 which is held by the slide cover 17 falls on top of the chamber 11 to seal off the chamber 11. Then (at Step 304) nitrogen gas is supplied to

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the inside of the chamber 11 as oxygen is expelled therefrom, and the chamber 11 is moved to a standby position (shown by the broken line B in Fig. 1). Now, as explained in U.S. Patent No. 4,718,967, by supplying nitrogen to the inside of the chamber 11 in order to expel oxygen therefrom, it becomes possible to shorten the time required for hardening the adhesive applied to the dicing tape 19.

Next, the shutter 9 is opened (Step 305) and irradiation to the dicing tape 19 is begun. At this time, the power output is controlled based on the illumination intensity value detected by the light detecting sensor 33 (Step 306). Namely, if the value detected by the light detecting sensor 33 is below the base illumination intensity, the voltage and/or the current outputted by the power source 29 is increased to raise the illumination intensity detected by the sensor 33 to the base illumination intensity, and if such value is greater than the base illumination intensity, the voltage and/or current outputted by the power source 29 is reduced to lower the illumination intensity detected by the sensor 33 to the base illumination intensity. In this way, when the lamp 5 is new, relatively little power needs to be supplied thereto, and when the lamp 5 deteriorates, more power can be supplied in accordance with the degree of deterioration. As a result, it becomes possible to save energy by reducing the power consumed by the apparatus.

Next, the drive portion 35 (motor 57) is operated and the chamber 11 is moved (Step 307) at the speed set with the touch panel 63 to uniformly irradiate the entire dicing tape with light. Then the shutter 9 is closed (Step 308). At this time, the power outputted by the power source 29 returns to the standby value (e.g., one-half the maximum value). And then the process is completed by removing the workpiece W from the apparatus (Step 309).

As described above, because the illumination apparatus of the present invention can be controlled to emit light at a prescribed illumination intensity, it is possible to avoid

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the damage to the semiconductor wafer and dicing tape. Moreover, the illumination apparatus of the present invention makes it possible to reduce the amount of power consumed.

Furthermore, because light is emitted at a prescribed illumination intensity, it is easy to adjust the quantity of light used for irradiating a workpiece W. Namely, by prescribing a speed for the chamber 11, it becomes extremely easy to control the quantity of light used for irradiating a workpiece W, and this makes it possible to use the same quantity of light every time irradiation is carried out. Furthermore, by making it possible to vary the speed of the chamber 11, it becomes easy to adjust quantity of light emitted by the lamp in accordance with the size of the IC chip to be diced and the UV sensitivity of the dicing tape.

In particular, when the above-described structure for controlling a prescribed illumination intensity is used in an illumination apparatus equipped with means for removing oxygen from the inside of the chamber, it becomes possible to accurately control the adhesive strength of the dicing tape.

In the embodiment described above, the workpiece W was irradiated with light as it was moved together with the chamber. However, the present invention is in no way limited to this arrangement, and it is also possible to keep the workpiece W fixed while moving the lamp. Furthermore, it is possible to construct a suitable illumination apparatus which can irradiate a workpiece without relative movement between the workpiece and the lamp. In this case, the quantity of light can be adjusted by adjusting the speed of the shutter. When the present invention is used with this type of illumination apparatus, it is possible to use the same quantity of light every time irradiation is carried out by setting a prescribed shutter speed for the lamp, and this has the advantage of making it possible to adjust the quantity of light merely by controlling the shutter speed.

As described above, the present invention makes it

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possible to irradiate dicing tape with light normally having a prescribed illumination intensity. In this way, it is possible to avoid the damage to the semiconductor wafer and dicing tape that can occur when using too high of an illumination intensity. Furthermore, by setting a prescribed illumination intensity, it becomes possible to easily control the quantity of light used to irradiate a workpiece, and this in turn makes it possible to adjust the quantity of light to suit the type of dicing tape.

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WHAT IS CLAIMED IS:

1. An illumination apparatus for irradiating dicing tape which has an adhesive applied thereto, comprising:

a light source for irradiating the dicing tape with light in order to weaken the adhesive strength of the adhesive;

power source for supplying electrical power to the light source;

means for setting a base illumination intensity; and

control means for controlling the electrical power supplied from the power source to the light source in order to cause the light source to emit light at a base illumination intensity set by the base illumination intensity setting means.

2. The illumination apparatus of Claim 1, further comprising moving means to create relative motion between the dicing tape and the light source.

3. The illumination apparatus of Claim 2, further comprising speed adjusting means for adjusting the speed of motion created by the moving means.

4. The illumination apparatus of Claim 2, wherein the moving means includes a chamber for housing the dicing tape and a cover for sealing the chamber.

5. The illumination apparatus of Claim 3, wherein the moving means includes a chamber for housing the dicing tape and a cover for sealing the chamber.

6. The illumination apparatus of Claim 4, further comprising deoxygenating means for removing oxygen from the inside of the chamber.

7. The illumination apparatus of Claim 5, further comprising

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deoxygenating means for removing oxygen from the inside of the chamber.

8. The illumination apparatus of Claim 1, wherein the control means includes light detecting means to detect the illumination intensity of the light emitted by the light source.

9. The illumination apparatus of Claim 4, wherein the moving means further includes at least one guide rail for guiding the motion of the chamber, a belt which is connected to the chamber, first and second pulleys for suspending the belt, and a motor connected to at least one of the first and second pulleys.

10. The illumination apparatus of Claim 5, wherein the moving means further includes at least one guide rail for guiding the motion of the chamber, a belt which is connected to the chamber, first and second pulleys for suspending the belt, and a motor connected to at least one of the first and second pulleys.

11. A method of irradiating dicing tape which has an adhesive applied thereto, comprising the steps of:

irradiating the dicing tape with light emitted from a light source;

controlling the power supplied from a power source to the light source in order to cause the light source to emit light at a prescribed illumination intensity.

12. The method of Claim 11, further including the step of creating relative motion between the dicing tape and the light source.

13. The method of Claim 12, wherein the step of controlling the power supplied to the light source includes the step of detecting the illumination intensity of the light emitted by

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the light source.

14. Illumination apparatus for irradiating dicing tape substantially as hereinbefore described with reference to any one of the accompanying drawings.

15. A method of irradiating dicing tape, the method substantially as hereinbefore described with reference to any one of the accompanying drawings.

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The Patent Office

16

Application No: GB 9623114.7
Claims searched: 1-15

Examiner: David Mobbs
Date of search: 20 January 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): G3R RBK

Int Cl (Ed.6): H01L 21/30, 21/302, 21/78, 21/782, 21/784, 21/786.

Other: ONLINE: WPI.

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	GB 2,004,090 A	COBERLY & ASSOCIATES	1-13
Y	US 4,718,967	EFUESUKEI KABUSHIKI KAISHA	1-13
Y	JP 6196555 A	NITTO DENKO CORPN - cited from the Japanese abstract and the Derwent abstract.	1-13

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

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